Package ‘LVMMCOR’

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Title A Latent Variable Model for Mixed Continuous and Ordinal Responses

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Description A model for mixed ordinal and continuous responses is presented where the heteroscedasticity of the variance of the continuous response is also modeled. In this model ordinal response can be dependent on the continuous response. The aim is to use an approach similar to that of Heckman (1978) for the joint modelling of the ordinal and continuous responses. With this model, the dependence between responses can be taken into account by the correlation between errors in the models for continuous and ordinal responses

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LVMMCOR-package *A Latent Variable Model for Mixed Continuous and Ordinal Responses.*

Description

A model for mixed ordinal and continuous responses is presented where the heteroscedasticity of the variance of the continuous response is also modeled.

Details

Package:	LVMMCOR
Type:	Package
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Author(s)

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References

Bahrami Samani, E., Ganjali, M. and Khodaddadi, A. (2008). A Latent Variable Model for Mixed Continuous and Ordinal Responses. Journal of Statistical Theory and Applications. 7(3):337-349.

Examples

```
data("Bahrami")
gender<-Bahrami$ GENDER
age<-Bahrami$AGE
duration <-Bahrami$ DURATION
y<-Bahrami$ STEATOS
z<-Bahrami$  BMI
sbp<-Bahrami$ SBP
X=cbind(gender,age,duration ,sbp)
P<-lm(z~X)[[1]]
names(P)<-paste("Con_",names(P),sep="")
Q<-polr(factor(y)~X)[[1]]
names(Q)<-paste("Ord_",names(Q),sep="")
W=c(cor(y,z),polr(factor(y)~X)[[2]],var(z))
names(W)=c("Corr","cut_point1","cut_point2","Variance of Continous Response")
ini=c(P,Q,W)
```

```
p=5;
q=4;
LVMMCOR(ini,X=X,y=y,z=z,p=p,q=q)
```

Bahrami *Body Mass Index and Steatosis Data*

Description

The medical data set is obtained from an observational study in the Taleghani hospital in Tehran. These data record the Steatosis and BMI for 15 diabetic patients. Steatosis is the process describing the abnormal retention of lipids within a cell. It reflects an impair of the normal process of synthesis and breakdown of triglyceride fat. Excess lipid accumulates in vescles that displace the cytoplasm. BMI is a statistical measure of the weight of body mass index. A person scaled height body mass index may be accurately calculated using any of the formulas such as BMI=w/H^2 where W is weight and H is height. As explanatory variable for both Steatosis and BMI, the systolic blood pressure (SBP) is defined as the peak pressure in the arteries, which occurs near the beginning of the cardiac cycle. The normal rate, in adult humans, for systolic is near but less than 120 mmHg. As another explanatory variable, duration of diabet is an amount of time or a particular time interval which a person take diabet (a metabolic disorder characterized by high blood suger and other signs). Two more explanatory variables are age and gender.

Usage

```
data(Bahrami)
```

Format

A data frame with 15 observations on the following 6 variables:AGE,DURATION,SBP,STEATOS,BMI,GENDER

Source

The medical data set is obtained from an observational study in the Taleghani hospital in Tehran.

References

Bahrami Samani, E., Ganjali, M. and Khodaddadi, A. (2008). A Latent Variable Model for Mixed Continuous and Ordinal Responses. Journal of Statistical Theory and Applications. 7(3):337-349.

LVMMCOR *A Latent Variable Model for Mixed Continuous and Ordinal Responses.*

Description

A model for mixed ordinal and continuous responses is presented where the heteroscedasticity of the variance of the continuous response is also modeled. In this model ordinal response can be dependent on the continuous response. The aim is to use an approach similar to that of Heckman (1978) for the joint modelling of the ordinal and continuous responses. With this model, the dependence between responses can be taken into account by the correlation between errors in the models for continuous and ordinal responses.

Usage

```
LVMMCOR(ini = NA, X, y, z, p, q, ...)
```

Arguments

`ini`	Initial values
`X`	Design matrix
`z`	Continuous responses
`y`	Ordinal responses with three levels
`p`	Order of dimension of continuous responses
`q`	Order of dimension of ordinal responses
`...`	Other arguments

Details

Models for LVMMCOR are specified symbolically. A typical model has the form response1 ~ terms and response2 ~ terms where response1and response2 are the (numeric) ordinal and continuous responses vector and terms is a series of terms which specifies a linear predictor for responses. A terms specification of the form first + second indicates all the terms in first together with all the terms in second with duplicates removed. A specification of the form first:second indicates the set of terms obtained by taking the interactions of all terms in first with all terms in second. The specification first*second indicates the cross of first and second. This is the same as first + second + first:second.

Value

`Continuous Response`
: Coefficient of continuous response

`Variance of Continuous Response`
: Variance of continuous response

`Ordinal Response`
: Coefficient of ordinal response

`Cut points`	Cut points for ordinal response
`Correlation`	Coefficient of continuous response
`Hessian`	Hessian matrix
`convergence`	An integer code. 0 indicates successful convergence

Note

Supportted by Shahid Beheshti University

Author(s)

Bahrami Samani and Nourallah Tazikeh Miyandarreh

References

Bahrami Samani, E., Ganjali, M. and Khodaddadi, A. (2008). A Latent Variable Model for Mixed Continuous and Ordinal Responses. Journal of Statistical Theory and Applications. 7(3):337-349.

See Also

`nlminb`,`fdHess`

Examples

```
data("Bahrami")
gender<-Bahrami$ GENDER
age<-Bahrami$AGE
duration <-Bahrami$ DURATION
y<-Bahrami$ STEATOS
z<-Bahrami$  BMI
sbp<-Bahrami$ SBP
X=cbind(gender,age,duration ,sbp)
P<-lm(z~X)[[1]]
names(P)<-paste("Con_",names(P),sep="")
Q<-polr(factor(y)~X)[[1]]
names(Q)<-paste("Ord_",names(Q),sep="")
W=c(cor(y,z),polr(factor(y)~X)[[2]],var(z))
names(W)=c("Corr","cut_point1","cut_point2","Variance of Continous Response")
ini=c(P,Q,W)
p=5;
q=4;
LVMMCOR(ini,X=X,y=y,z=z,p=p,q=q)

## The function is currently defined as
structure(function (x, ...)
UseMethod("LVMMCOR"), class = "LVMMCOR")
```

LVMMCOR.default — *A Latent Variable Model for Mixed Continuous and Ordinal Responses.*

Description

A model for mixed ordinal and continuous responses is presented where the heteroscedasticity of the variance of the continuous response is also modeled. In this model ordinal response can be dependent on the continuous response. The aim is to use an approach similar to that of Heckman (1978) for the joint modelling of the ordinal and continuous responses. With this model, the dependence between responses can be taken into account by the correlation between errors in the models for continuous and ordinal responses.

Usage

```
## Default S3 method:
LVMMCOR(ini = NA, X, y, z, p, q, ...)
```

Arguments

`ini`	Initial values
`X`	Design matrix
`z`	Continuous responses
`y`	Ordinal responses with three Levels
`p`	Order of dimension of continuous responses
`q`	Order of dimension of ordinal responses
`...`	Other arguments

Details

Models for LVMMCOR are specified symbolically. A typical model has the form response1 ~ terms and response2 ~ terms where response1and response2 are the (numeric) ordinal and continuous responses vector and terms is a series of terms which specifies a linear predictor for responses. A terms specification of the form first + second indicates all the terms in first together with all the terms in second with duplicates removed. A specification of the form first:second indicates the set of terms obtained by taking the interactions of all terms in first with all terms in second. The specification first*second indicates the cross of first and second. This is the same as first + second + first:second.

Value

`Continuous Response`
: Coefficient of continuous response

`Variance of Continuous Response`
: Variance of continuous response

`Ordinal response`
: Coefficient of ordinal response

`Cut points`
: Cut points for ordinal response

`Correlation`
: Coefficient of continuous response

`Hessian`
: Hessian matrix

`convergence`
: An integer code. 0 indicates successful convergence.

Note

Supportted by Shahid Beheshti University

Author(s)

Bahrami Samani and Nourallah Tazikeh Miyandarreh

References

Bahrami Samani, E., Ganjali, M. and Khodaddadi, A. (2008). A Latent Variable Model for Mixed Continuous and Ordinal Responses. Journal of Statistical Theory and Applications. 7(3):337-349.

See Also

`nlminb`,`fdHess`

Examples

```
function (ini = NA, X, y, z, p, q, ...)
{
    options(warn = -1)
    f <- function(ini, X, y, z, p, q) {
        X = cbind(1, X)
        y <- as.vector(y)
        z <- as.vector(z)
        ini <- as.vector(ini)
        X <- as.matrix(X)
        n = nrow(X)
        muz = muy = muygivenzx = q2 = q1 = l1 = l2 = l3 = muygivenzx = as.vector(0)
        sez <- exp(ini[p + q + 4])
        seygivenzx <- (1 - (ini[p + q + 1])^2)
        for (i in 1:n) {
            muz[i] <- as.numeric(t(ini[1:p]) %*% X[i, ])
            muy[i] <- as.numeric(t(ini[(p + 1):(p + q)]) %*%
                X[i, -1])
            muygivenzx[i] <- muy[i] + (ini[p + q + 1] * (z[i] -
                muz[i]))/sez
            q1[i] <- (ini[p + q + 2] - muygivenzx[i])/sqrt(seygivenzx)
            q2[i] <- (ini[p + q + 3] - muygivenzx[i])/sqrt(seygivenzx)
            l1[i] <- log(pnorm(q1[i])) + log(dnorm(z[i], muz[i],
                sez))
            l2[i] <- log(pnorm(q2[i]) - pnorm(q1[i])) + log(dnorm(z[i],
                muz[i], sez))
```

```
        l3[i] <- log(1 - pnorm(q2[i])) + log(dnorm(z[i],
            muz[i], sez))
    }
    data0 <- cbind(y, l1)
    data1 <- cbind(y, l2)
    data2 <- cbind(y, l3)
    data0[data0[, 1] == 1, 2] <- 0
    data0[data0[, 1] == 2, 2] <- 0
    data1[data1[, 1] == 0, 2] <- 0
    data1[data1[, 1] == 2, 2] <- 0
    data2[data2[, 1] == 0, 2] <- 0
    data2[data2[, 1] == 1, 2] <- 0
    t0 <- sum(data0[, 2])
    t1 <- sum(data1[, 2])
    t2 <- sum(data2[, 2])
    t <- (c(t0, t1, t2))
    Tfinal <- sum(t)
    return(-Tfinal)
}
n = nlminb(ini, f, X = X, y = y, z = z, p = p, q = q, lower = c(rep(-Inf,
    length(ini)), -0.999, -Inf, -Inf, 0), upper = c(rep(Inf,
    length(ini)), 0.999, Inf, Inf, Inf), hessian = T)
h = fdHess(n$par, f, z = z, y = y, X, p, q)
h1 = h$Hessian
ih = ginv(h1)
se = sqrt(abs(diag(ih)))
n$Hessian <- h1
n$p <- p
n$q <- q
n$se <- as.vector(se)
n$call <- match.call()
class(n) <- "LVMMCOR"
object = n
Co.Re <- data.frame(Parameter = object$par[1:p], S.E = object$se[1:p],
    `Confidence Interval` = paste("(", round(object$par[1:p] -
        2 * object$se[1:p], 3), ",", round(object$par[1:p] +
        2 * object$se[1:p], 3), ")", sep = ""))
Or.Re <- data.frame(Parameter = object$par[(p + 1):(p + q)],
    S.E = object$se[(p + 1):(p + q)], `Confidence Interval` = paste("(",
        round(object$par[(p + 1):(p + q)] - 2 * object$se[(p +
            1):(p + q)], 3), ",", round(object$par[(p + 1):(p +
            q)] + 2 * object$se[(p + 1):(p + q)], 3), ")",
        sep = ""))
Cut.P <- data.frame(Parameter = object$par[(p + q + 2):(p +
  q + 3)], S.E = object$se[(p + q + 2):(p + q + 3)], `Confidence Interval` = paste("(",
    round(object$par[(p + q + 2):(p + q + 3)] - 2 * object$se[(p +
        q + 2):(p + q + 3)], 3), ",", round(object$par[(p +
        q + 2):(p + q + 3)] + 2 * object$se[(p + q + 2):(p +
        q + 3)], 3), ")", sep = ""))
Cor <- data.frame(Parameter = object$par[p + q + 1], S.E = object$se[p +
    q + 1], `Confidence Interval` = paste("(", round(object$par[p +
    q + 1] - 2 * object$se[p + q + 1], 3), ",", round(object$par[p +
    q + 1] + 2 * object$se[p + q + 1], 3), ")", sep = ""))
```

```
  Var <- data.frame(Parameter = object$par[p + q + 4], S.E = object$se[p +
      q + 4], `Confidence Interval` = paste("(", round(object$par[p +
      q + 4] - 2 * object$se[p + q + 4], 3), ",", round(object$par[p +
      q + 4] + 2 * object$se[p + q + 4], 3), ")", sep = ""))
  row.names(Cut.P) <- c("cut point1", "cut point2")
  res <- list(call = object$call, `Continuos Response` = Co.Re,
      `Variance Of Countinous Response` = Var, `Ordinal Response` = Or.Re,
      `Cut points` = Cut.P, Correlation = Cor)
  res$Hessian <- h1
  res$convergence <- n$convergence
  res$call <- match.call()
  class(res) <- "LVMMCOR"
  res
}
```

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